

**Powhatan Creek Watershed
Management Plan**

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DRAFT

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James City County, Virginia

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Powhatan Creek Watershed Management Report

Table of Contents

	Page
List of Tables	ii
List of Figures	iii
Executive Summary	iv
Section I: Introduction	1
Section II: Watershed Goals	7
Section III: Watershed Recommendations	11
A. Land Use Planning	11
B. Aquatic Buffers	14
C. Better Site Design	17
D. Stormwater Management	23
E. Conservation Areas	28
F. Watershed Education	29
G. Non-Stormwater Discharges	32
Section IV: Costs and Schedule	33
Section V: Subwatershed Management Plans	36
References	80
Appendix A. The Economics of Watershed Protection	A-1
Appendix B. Watershed Education CD	A-2
Appendix C. Resource Protection Area Extension Map	A-3
Non-Tidal Mainstream Buffer Map	
Tidal Mainstream Buffer Map	
Appendix D. James City County Codes and Ordinances Worksheet	A-4

Powhatan Creek Watershed Management Report

List of Tables

No.	Title	Page
E-1.	Subwatershed Goals	vi
E-2.	Priorities and Costs for Watershed Protection and Restoration in Powhatan Creek	viii
1.1	Powhatan Creek Subwatershed Assessment Results	2
1.2	Potential Stream Restoration Areas and Associated Retrofits	3
1.3	Powhatan Creek Conservation Area Priorities	4
1.4	Priority Stormwater Retrofits.....	6
3.1	Land Use Strategies for Powhatan Creek Watershed.....	13
3.2	Buffer Strategies for Powhatan Creek Subwatersheds	16
3.3	VDOT Minimum Local Street Width Requirements	19
3.4	James City County Setback, Frontage, and Open Space Requirements	20
3.5	Better Site Design Strategies for Powhatan Creek Subwatersheds	22
3.6	Prioritization of Potential Sites for Regional Facilities to Manage Stormwater Runoff from Future Development	26
3.7	Education and Stewardship Program Recommendations	31
4.1	Implementation and Cost Schedule	33

Powhatan Creek Watershed Management Report

List of Figures

No.	Title	Page
1.	Powhatan Creek Subwatershed Classification Map.....	viii
2.	Priority Conservation Areas.....	6
3.	Stormwater Criteria Designations.....	24
4.	Regional Pond and Priority Retrofit Locations.....	27
5.	Subwatershed 201.....	37
6.	Subwatershed 202.....	41
7.	Subwatershed 203.....	44
8.	Subwatershed 204	47
9.	Subwatershed 205	51
10.	Subwatershed 206	55
11.	Subwatershed 207	58
12.	Subwatershed 208	61
13.	Subwatershed 209	65
14.	Subwatershed 210	68
15.	Non-tidal Mainstem	71
16.	Tidal-Creek Segment	76
	Resource Protection Area Extension Map	Appendix C
	Non-Tidal Mainstream Buffer Map	
	Tidal Mainstream Buffer Map	

Executive Summary

This watershed management plan provides a summary of the findings from the Powhatan Creek baseline report, the three special studies and the stakeholder process conducted by the Center for Watershed Protection, the James River Association and James City County. A specific watershed management plan and accompanying maps have been drafted for the 12 subwatersheds based on the eight tools of watershed protection. The subwatershed maps serve as a blueprint for the protection and restoration of Powhatan Creek and may be used as planning maps during the implementation of the watershed management plan and as an important tool during the development review process.

The 22 square mile Powhatan Creek watershed is truly a state and national treasure with its historic past and present biodiversity. The mouth of the creek discharges to the James River near Jamestown Island, the site of the first permanent settlement in North America and a major tourist destination. The scenic Powhatan Creek is also notable for its exceptional biodiversity and bottomland wetlands. It was recently ranked as having the greatest significance for biodiversity and natural areas in the lower Peninsula of Virginia (Clark, 1993). Rare, threatened or endangered plants such as the small whorled pogonia, Virginia least trillium, and false hopsedge are found here. Bald eagle habitat and an important heron nesting colony are located within Powhatan Creek's expansive floodplain wetlands.

Rapid development seen in the last two decades poses a threat to water quality and natural habitats in Powhatan Creek. Impervious cover is an indicator of the extent and pattern of growth in the watershed, and this growth pattern over the years is very revealing. In 1970, watershed impervious cover was estimated to be 3%, but grew to 8% in 1998, 9.8% in 2000, and is projected to reach a maximum of 15.5% in the future. Prior research has shown that stream and wetland quality begins to decline when the amount of impervious cover in a watershed exceeds 10%. Based on our latest estimates, Powhatan Creek appears to be very close to crossing this key threshold.

The principal effects of impervious cover in Powhatan Creek include:

- Changes in hydrology of streams, wetlands and floodplains
- Increased pollutant loads delivered in urban stormwater (bacteria, sediment, nutrients)
- Channel erosion in headwater streams
- Water level fluctuations that degrade wetlands and rare, threatened, or endangered plant species habitat
- Favors the establishment of invasive plant species
- Fragmentation of contiguous forests
- Increased flooding

Based on a widely used stream classification model, eight subwatersheds were classified as sensitive and only four subwatersheds were classified as impacted in 1998. Recent growth in the watershed

Powhatan Creek Watershed Management Report

has been rapid, and as of 2000, six subwatersheds are classified as sensitive, and six are now classified as impacted. Based on future growth in the watershed, it is likely that all subwatersheds will shift to the impacted category under the current zoning in the coming decades.

Watershed residents and other stakeholders play a vital role in the creation of a watershed management plan. It is important to involve the citizens, businesses, and other interested parties in the development of a watershed plan, since they will have to live with the decisions which are made. Stakeholders also bring to the table the issues which are important to them. Their participation gives them a stake in the outcome and helps to ensure plan implementation. Two public meetings were held with watershed stakeholders; the first covered the baseline assessment and fieldwork which was performed by the Center, the second engaged participants in the process of setting goals for the subwatersheds as well as the watershed as a whole. The eight overall watershed protection and restoration goals identified by the stakeholders are:

1. Prevent further degradation of water quality in Powhatan Creek and maintain the outstanding quality of tidal and nontidal mainstem wetlands. Extend Resource Protection Areas (RPA) to protect all perennial streams and connected wetlands.
2. Maintain biological and habitat diversity and promote habitat connectivity by protecting wildlife and riparian corridors between watersheds, subwatersheds, and the tidal and nontidal portions of Powhatan Creek.
3. Develop an “affordable and effective” watershed management plan that can be implemented by James City County.
4. Establish a transparent and stream-lined permitting process, and provide cost effective and incentive based regulations or guidelines for “green” development.
5. Improve the existing mechanisms for completing stormwater maintenance and retrofitting, and develop a mechanism for adequate long-term funding.
6. Link the unique history and culture of Jamestown and Colonial Williamsburg with Powhatan Creek watershed protection. Implement the majority of the watershed plan by the 2007 Jamestown Celebration.
7. Promote watershed awareness and active stewardship among residents, community associations, businesses, and seasonal visitors through educational programs, recreational opportunities, and participatory watershed activities.
8. Restore the physical integrity of degraded headwater streams where possible and protect the high quality streams from the negative morphological effects associated with increased urbanization.

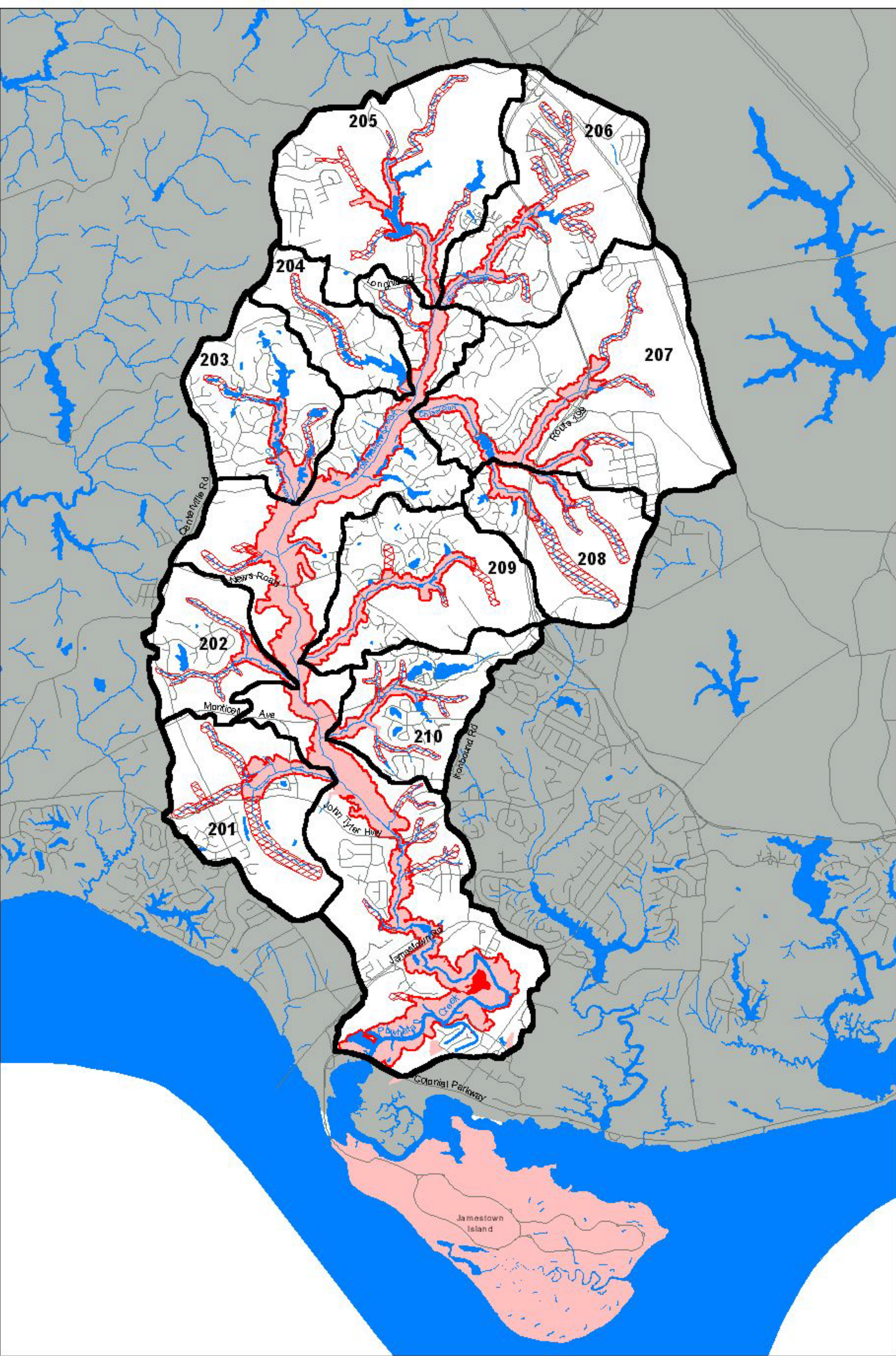
Powhatan Creek Watershed Management Report

Process

The 22 square mile Powhatan Creek watershed was divided into 12 subwatersheds from one to four square miles in area to create individual planning units (Figure 1). Land use and impervious cover were analyzed for each subwatershed in order to set expectations for current and future water quality and habitat conditions. Field conditions and conservation areas were evaluated to check expectations developed in the land use and impervious cover analysis. Together with the results of our conservation area work and the stream habitat assessment, draft goals were created for subwatersheds based on science and the existing and potential future land use. It was determined that Powhatan Creek includes a mix of relatively high quality subwatersheds with considerable biodiversity, a number of subwatersheds where stream conditions and habitat diversity have already been impacted by large regional stormwater ponds, and a high quality wetland complex along the mainstem.

A sensible philosophy was devised by the Center along with stakeholders to protect the high quality streams and conservation areas using land use and conservation tools. At the same, provide for additional development in degraded subwatersheds, with a goal of preventing further degradation by using stormwater retrofits, effective stormwater management, stream restoration, on-lot stormwater management and watershed education programs. In cases where development is going to occur in sensitive watersheds, special stormwater criteria, where impervious cover and stormwater runoff are reduced, have been created in order to reduce the impacts. In addition, the mainstem tidal section was designated as a Sensitive Resource Area, which reflects the need for special tools to help protect the significant natural resources of this area. The stakeholder process helped develop a broad consensus for these goals and added even more specific goals for both the entire watershed and individual subwatershed planning units. A summary of the individual subwatershed goals is as follows:

Table E-1. Subwatershed Goals			
Subwatersheds	Current Status / Future goal	Watershed Goals	Tools
201, 202, 205, 208, 209, Mainstem nontidal	Sensitive / Sensitive <i>less than 10% impervious cover</i>	Preserve important conservation areas, sensitive streams and contiguous forest	Conservation easements, land acquisition, limit re-zoning, open space transfer; when development does occur -- cluster and use Special Stormwater Criteria (SSC)
203, 204, 206, 207, 210	Impacted / Impacted <i>10 -25% impervious cover</i>	Reduce pollutant sources, improve pond aesthetics and uptake, restore degraded streams and protect streams from further degradation	Direct development here, implement watershed education and stewardship programs, stormwater retrofits, on-lot stormwater practices, and stream restoration, consider up-zoning



LEGEND

- Watershed Boundary
- Subwatershed Boundary
- Current RPA and RPA Buffer
- Recommended RPA Extension
- Hydrology

Powhatan Creek Watershed

4000 0 4000 Feet

A north arrow pointing upwards and a scale bar indicating distances of 4000, 0, and 4000 feet.

Powhatan Creek Watershed Management Report

Mainstem Tidal	Impacted / Impacted <i>13.6%</i> <i>impervious cover</i>	Sensitive Resource Area Minimize increases in impervious cover, maintain high quality of wetland habitat, maintain buffers for the preservation of marsh wildlife communities and water quality	Increase buffer, cluster to preserve buffer, open space design, limit up-zoning, open space trading
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Recommendations

Prioritized implementation recommendations for the Powhatan Creek watershed are summarized in Table E-2. Preliminary cost estimates and potential responsible parties have been identified so that financial resources can be allocated and staff roles can be defined. Real watershed protection requires a multi-faceted approach which combines land use decisions with on-the-ground implementation, education and protection of watershed functions. This approach strives for permanent protection, and attempts to minimize long-term costs by implementing proactive, preventative solutions. This method is not inexpensive, our estimate is \$300,000 a year over 5 - 6 years, this number would increase with a larger open space acquisition or conservation easement program. Long-term protection of water quality, fisheries, quality of life and biodiversity have quantifiable community benefits including increased property values and enhanced quality of life, which compound over time. More details on the economic benefits of watershed protection can be found in Appendix A.

Another key component of this watershed plan is measuring and monitoring the success of the plan. In Powhatan Creek, this consists of monitoring the effects of management measures on stream channel stability, water quality, RTE species and impervious cover. This will enable county staff to learn from the successes and challenges of plan implementation and craft better strategies in the future.

Powhatan Creek Watershed Management Report

Table E-2. Priorities and Costs for Watershed Protection and Restoration in Powhatan Creek					
Priority	Goals Achieved	Protection Tool or Evaluation Measure	Where	Costs to JCC and Action	Responsible Party
1	1,2,3	Use subwatershed maps to review future development projects, negotiate proffers, and review re-zoning requests	Watershed wide	Minimal <i>Use the subwatershed maps created by the Center</i>	JCC Planning, Development Management, Environmental Division
2	1,2,3	Implement new RPA boundary based on perennial streams	Watershed wide (See Map in Appendix D)	Minimal <i>Use the new layer created by CWP (perhaps further improve with help of William & Mary)</i>	JCC Environmental Division
3	1,2,3	Prohibit re-zoning which increases impervious cover in sensitive subwatersheds	Sensitive subwatersheds (201, 202, 205, 208, 209, tidal and non-tidal mainstem).	Minimal <i>Policy change</i>	Planning Board
4	1,2,3,4	Cluster down - Ability to reduce lot sizes in low density zoning areas to create additional open space	Sensitive Subwatersheds (201, 202, 205, 208, 209, Tidal and non-tidal Mainstem)	Small 0.1 FTE (Full-Time-Employee) Watershed Planner <i>Ordinance or code change or Overlay zone</i>	JCC Planning

Powhatan Creek Watershed Management Report

Table E-2. Priorities and Costs for Watershed Protection and Restoration in Powhatan Creek					
Priority	Goals Achieved	Protection Tool or Evaluation Measure	Where	Costs to JCC and Action	Responsible Party
5	1,2,3	Open Space Trading or Fee-in-lieu-- to acquire conservation areas and mainstem buffers (reduced open space requirement in certain watersheds in exchange for protection of conservation areas and the mainstem buffer)	Subwatersheds (203, 204, 206, 207, 210)	Minimal 0.1 FTE Watershed Planner <i>Ordinance or code change or Overlay zone</i>	JCC Planning
6	1,2,3,6	Purchase conservation easements in conservation areas and along mainstem buffers (Table 1.3 and Figure 2)	Sensitive subwatersheds (201, 202, 205, 208, 209, tidal and non-tidal mainstem).	Very Expensive (1million per year) <i>Goal: Preserve 250 - 300 acres a year over 6 years</i>	JCC Planning, Development Management, Williamsburg Land Trust
7	1,2	Special stormwater criteria in sensitive stream areas and conservation areas	201, 202, 203 (small section), 205, 208, 209, tidal and non-tidal mainstem	Small <i>stormwater ordinance change</i>	JCC Environmental Division
8	3	Hire a watershed planner/restoration coordinator	County wide	Expensive 1.0 FTE Watershed Planner \$35 to \$40K a year <i>Implementation of watershed plan</i>	Environmental Division

Powhatan Creek Watershed Management Report

Table E-2. Priorities and Costs for Watershed Protection and Restoration in Powhatan Creek					
Priority	Goals Achieved	Protection Tool or Evaluation Measure	Where	Costs to JCC and Action	Responsible Party
9	1,5,8	Stormwater retrofits	201, 202, 205, 206, 207, 210	Expensive \$60k / year <i>Retrofit two facilities a year for 5 years (could be paid for with stormwater utility)</i>	JCC Environmental Division / Watershed Planner/ Restoration Coordinator
10	1,5	Long term maintenance of stormwater facilities / Stormwater utility	Watershed Wide	Expensive 0.5 FTE Stormwater engineer <i>Creation of a stormwater utility</i>	Planning board/ JCC Environmental Division
11	1,3,4	Impervious cover limit of 10%	208, 209	Small 0.05 FTE Watershed Planner <i>Ordinance</i>	JCC Planning
12	1,3,7,8	Expand BMP homeowner education program to include lawn care and conversion, pet waste, car washing and other watershed behaviors	Watershed wide	Small \$5 to \$7.5K year (FOP) <i>CD included with powerpoint slides for presentations to HOAs</i>	JCC Environmental Division/ Friends of Powhatan Creek
13	1,3,4	Better site design	County wide	Small 0.1 FTE Watershed Planner <i>Zoning changes</i>	Planning division

Powhatan Creek Watershed Management Report

Table E-2. Priorities and Costs for Watershed Protection and Restoration in Powhatan Creek					
Priority	Goals Achieved	Protection Tool or Evaluation Measure	Where	Costs to JCC and Action	Responsible Party
14	1,3,4	Encourage Better Site Design across watershed –workshop with developers and planning staff	Watershed wide	Minimal <i>(streamlined review process) and workshop for review staff and developers (Center will make part of Yarmouth Stakeholder Involvement process)</i>	Center for Watershed Protection/ JCC Environmental Division
15	1,7	Golf course management task force to discuss potential improvements in turf management/nutrients, pesticides, buffer protection, stream crossings and invasive species	202, 203, 204, 207	Minimal 0.05 FTE Watershed Planner <i>Facilitate task force</i>	Fords Colony/ JCC Environmental Division
16	1,8	Restore three stream sections over 5 years	201,206,207,210	Expensive \$100k a year for five years Prioritize restoration sites Geomorphic prioritization (\$30k or staff time) <i>Oversee restoration projects</i>	JCC Environmental Division Watershed Planner/ Restoration Coordinator
17	1,3	Monitor the effects of the Special Stormwater Criteria (SSC), JCC's regular criteria and the stream restoration efforts on stream channels	Watershed wide	Small Estimate of \$10 - \$15k/year <i>Evaluate the effectiveness of protection and restoration efforts/criteria</i>	Environmental Division and Greg Hancock, William and Mary

Powhatan Creek Watershed Management Report

Table E-2. Priorities and Costs for Watershed Protection and Restoration in Powhatan Creek					
Priority	Goals Achieved	Protection Tool or Evaluation Measure	Where	Costs to JCC and Action	Responsible Party
18	1,2,3	Plan for & monitor the protection of the RTE species in New Town - monitoring should continue through the development process	Subwatersheds 208/209	Small \$5k a year <i>Evaluate the effectiveness of protection efforts</i>	Donna Ware, William and Mary
19	1,2	RPA signage with new development	Watershed wide	Small \$5 to \$10k/ year	JCC Environmental Division
20	6,7	Powhatan Creek Watershed Signs which link the 2007 Celebration	Mainstem bridge crossings	Small \$5k	JCC Environmental Division
21	1,2,7	Program for assisting landowners in buffer creation.	Watershed wide	Small 0.1 FTE Watershed Planner +\$6k for equipt <i>Work with schools to establish a seedling grow out station. Restoration coordinator or existing staff to help distribute trees.</i>	JCC Environmental Division - Restoration Coordinator, Friends of Powhatan Creek
22	1,2	Acquisition of priority conservation and other sensitive areas	Sensitive subwatersheds (201, 202, 205, 208, 209, tidal and non-tidal mainstem).	Minimal - (Redirect existing resources) <i>Target a portion of the Open Space acquisition fund to conservation areas in Powhatan</i>	JCC Parks and Recreation Division

Powhatan Creek Watershed Management Report

Table E-2. Priorities and Costs for Watershed Protection and Restoration in Powhatan Creek					
Priority	Goals Achieved	Protection Tool or Evaluation Measure	Where	Costs to JCC and Action	Responsible Party
23	1,3	Re-compute impervious cover for all subwatersheds in 5 years	Watershed wide	Small \$10-20K in year 5 <i>Re- compute impervious cover</i>	JCC GIS Department or CWP
24	1,5	Future regional stormwater facilities (2-3 over 5 years)	Options include: 204, 205, 206, 207, 208	Expensive (estimate 2-3 @ \$250k per facility) <i>Plan/ construct</i> <i>Have new users pay in</i>	Environmental Division
Total				•Expensive 2 FTEs \$1.5 million over 6 years Additional funds for conservation easements/open space protection	

Section I: Introduction

The 22 square mile Powhatan Creek watershed is truly a state and national treasure with its historic past and present biodiversity. The mouth of the creek discharges to the James River near Jamestown Island, the site of the first permanent settlement in North America and a major tourist destination. The scenic Powhatan Creek is also notable for its exceptional biodiversity. It was recently ranked as having the greatest significance for biodiversity and natural areas in the lower Peninsula of Virginia (Clark, 1993). Rare, threatened or endangered plants such as the small whorled pogonia, Virginia least trillium, and false hopsedge are found here. Bald eagle habitat and an important heron nesting colony are located within Powhatan Creek's expansive floodplain wetlands.

Based on a widely used stream classification model, eight subwatersheds were classified as sensitive and only four subwatersheds were classified as impacted in 1998. Recent growth in the watershed has been rapid, and as of 2000, six subwatersheds are classified as sensitive, and six are now classified as impacted. Based on future growth in the watershed, it is likely that all subwatersheds will shift to the impacted category under the current zoning in the coming decades. Clearly, it will be important to balance future growth with protection of Powhatan Creek and its natural resources.

Three special studies were performed to gain a better scientific understanding of the stream system; these included the *Stream and Floodplain Assessment*, the *Conservation Area Study*, and the *Stormwater Management Masterplan*. The *Stream and Floodplain Assessment* consisted of an instream habitat survey for the majority of the non-tidal watershed and reported on stream channel stability and habitat conditions in each of the subwatersheds. The conservation area study identified the presence of Rare, Threatened or Endangered (RTE) species, contiguous forest and high quality wetlands and identified potential threats and impacts to their existence. The stormwater master plan developed specific stormwater criteria for subwatersheds, identified existing stormwater practices for retrofit possibilities, and located potential regional stormwater facilities. Summary findings are presented below; more detailed reports of each study are available.

Stream Habitat and Floodplain Assessment

Stream habitat surveys show early and clear signs of stress in headwater streams. The influence of watershed development on the mainstem and tidal creek has been more difficult to detect, but these changes may be masked by the very recent nature of development, the extensive influence of beaver activity and the stormwater and open space requirements adopted by James City County in the past.

Outcomes

- identification of 4 subwatersheds in excellent condition
- identification of 3 subwatersheds in good condition
- identification of 4 subwatersheds in fair condition
- identification of 6 potential locations for stream restoration (Table 1.2)

Powhatan Creek Watershed Management Report

Table 1.1 contains the subwatershed rankings for habitat conditions as well as the amount of impervious cover in each subwatershed.

Table 1.1 Powhatan Creek Subwatershed Assessment Results				
Rank	Subwatershed	Impervious Cover	Habitat Score	Rating
1	205	5.1%	168	Excellent
2	Mainstem non-tidal	3.8%	164	Excellent
3	208	5.8%	160	Excellent
4	209	5.3%	159	Exc./Good
5	202	6.4%	148	Good
6	207	16.4%	144	Good
7	210	18.6%	142	Good/Fair
8	204	10.0%	132	Fair
9	206	14.7%	128	Fair
10	203	10.5%	124	Fair
11	201	6.8%	114	Fair
N/A	Mainstem tidal	13.6%	NA	Important fishery, shellfish beds and history
**Further details can be found in the <i>Powhatan Creek Stream Habitat and Floodplain Assessment</i> (Brown, 2001).				

Powhatan Creek Watershed Management Report

Table 1.2 Potential Stream Restoration Areas and Associated Retrofits				
Subwatershed	Catchment	Stream Reach *	Associated Retrofit (Rank)	Comments
201	Stem	201	R201-1 (7 of 16)	Recommended wetland/stream restoration of the ditched and drained wetland/stream system. Note presence of RTE species.
206	201-1	102, 103, 104	--	Restoration associated with incised, degraded stream channel conditions found along active nick points in the northern tributary. Proposed regional pond to manage stormwater from new and existing development.
206		201	R206-1 (1 of 8)	
206	202-1	106	R206-3 (4 of 16)	Eroded channel and nick points downstream of dry pond serving Prime Outlets. Retrofit of dry pond proposed for construction in conjunction with the stream restoration.
207	101-1, 101-2	101	R207-2 (2 of 8)	The lower portion of this highly incised and degraded reach would benefit from proposed regional facility. Note: Adjacent land zoned for limited Industry/Business.
207	202-1	103	R207-4 (1 of 16)	Pond to control unmanaged runoff from development upstream of proposed stream rehabilitation
210	204-1	109, 204	R210-1 (9 of 16)	Highly incised channel. Retrofit of dry pond to provide channel protection in recommended in conjunction with stream rehabilitation.

* Potential stream restoration reaches are denoted by blue crosshatches on the subwatershed management maps in Section 5. The stream reach numbering system is presented in Figure 8 and Figure 9 in the Powhatan Creek Watershed Stream and Floodplain Assessment Report (Brown, 2001).

Conservation Area Study

Based on field surveys, current Resource Protection Area (RPA) boundaries (state regulated areas) do not protect all vulnerable streams or conservation areas. The boundaries may need to be expanded or another mechanism must be developed to protect these areas. Of critical concern are populations of rare, threatened and endangered species, such as Small whorled pogonia, Virginia least trillium, New Jersey rush, false hopsedge, and Torrey's peat moss, which are widely dispersed across the watershed, and often located outside RPA boundaries. These species are highly vulnerable to watershed development. In addition, while extensive floodplain forest areas are protected within the RPA, upland forest areas are becoming smaller and more fragmented, and may deserve greater emphasis in land conservation. In previously developed areas with only a small buffer on the

Powhatan Creek Watershed Management Report

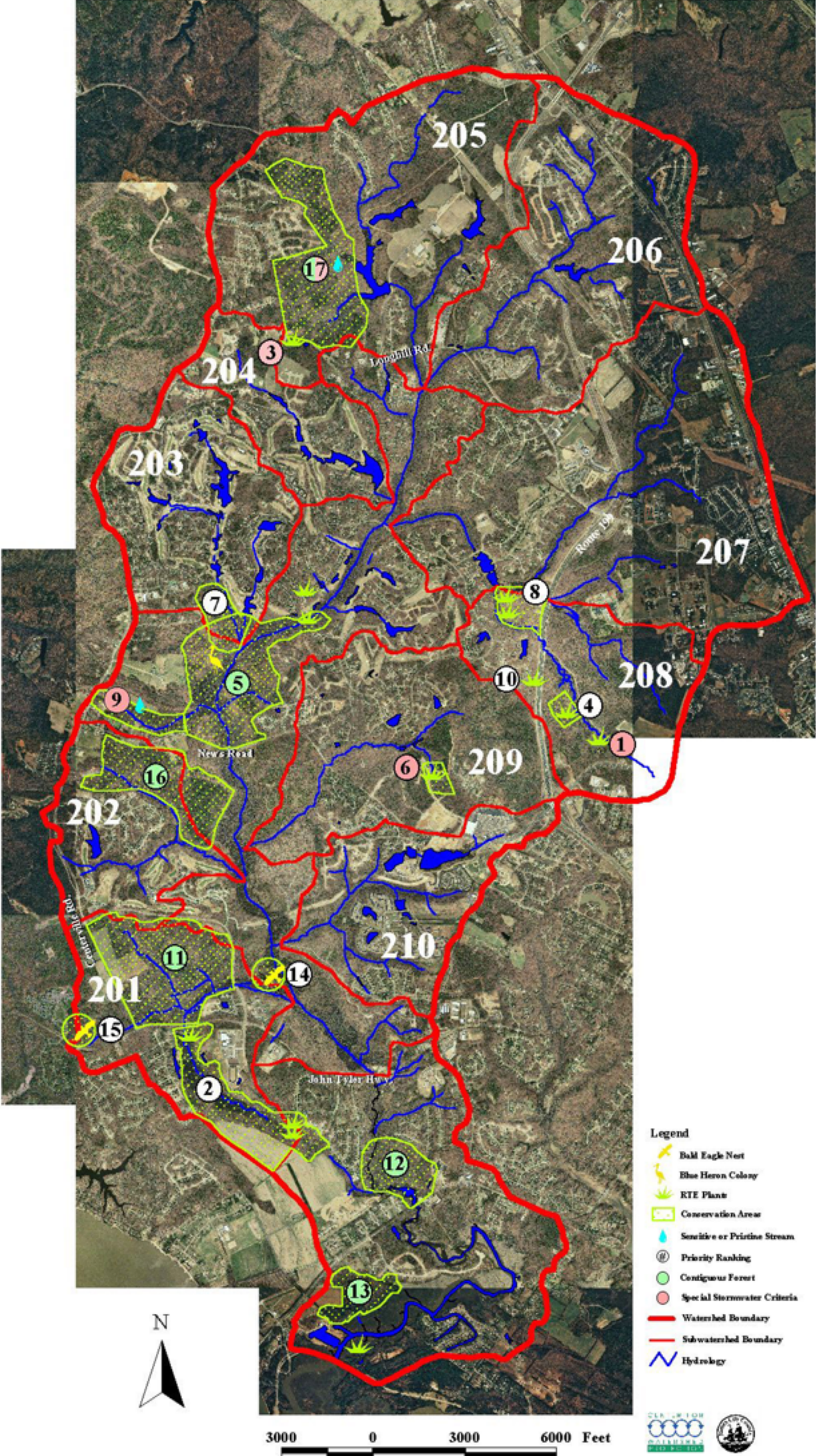
mainstem floodplain wetlands, invasive species have intruded into the wetland complex; these include Japanese knotweed, microstegium and phragmites.

Outcomes

- 17 priority conservation areas and management recommendations;
- 17 areas for land acquisition or easement (1800 total acres);
- Locations where the RPA protection should be extended;
- Recognition of the need for additional buffer to protect the high quality wetland complex of the tidal and non-tidal mainstem of Powhatan Creek (300 ft. minimum)

A description of the 17 priority conservation areas are listed in Table 1-3, as well as appropriate management recommendations. Figure 2 illustrates the locations of the conservation areas. One of the goals of the watershed management plan is to ensure the protection of these areas.

Table 1.3 Powhatan Creek Conservation Area Priorities				
Rank	Conservation Area #	Description	Total Score	Management Recommendation
1	C-25	VA least trillium New Town (NT)	64	Special Stormwater Criteria (SSC)
2	C-1/C-2/C-5	Paleochannel	59	Invasive Species Management
3	C-12/C-14	RTE wetland subwatershed 205	59	Special Stormwater Criteria
4	C-24	Small whorled pogonia (NT)	58	Greater Conservation
5	C-35	Contiguous forest/ heron rookery	57	Conservation/Acquisition
6	C-29	VA least trillium Jesters Ln	57	Conservation/Acquisition or SSC
7	C-9	Subwatershed 203 near rookery	55	Conservation/Acquisition
8	C-21	Small whorled pogonia 208 Ford's Colony (FC)	55	Conservation/Acquisition
9	C-34	High quality stream near News Rd.	54	Conservation/Acquisition or SSC
10	C-26	Small whorled pogonia (FC)	54	Conservation/ Management
11	C-4	Contiguous forest in 201	53	Conservation/Acquisition
12	C-41	Contiguous forest upper tidal	52	Conservation/Acquisition



**Figure 2: Powhatan
Priority Conservation Areas**

Powhatan Creek Watershed Management Report

Table 1.3 Powhatan Creek Conservation Area Priorities				
Rank	Conservation Area #	Description	Total Score	Management Recommendation
13	C-42/C-43	Contiguous forest lower tidal	52	Conservation/Acquisition
14	C-39	Eagles Nest above Rt. 5	52	Conservation/Acquisition
15	C-6	Eagles Nest on watershed border in 201	51	Conservation/Acquisition
16	C-7	Medium sized contiguous forest in 202	49	Conservation/Acquisition
17	C-13	Contiguous forest/ high quality streams in 205	49	Conservation/Acquisition or SSC
**Further details and scoring methods can be found in the <i>Powhatan Creek Conservation Area Report</i> (Sturm, 2001).				

Stormwater Management

While JCC has strong stormwater management criteria, the existing management practices are not enough to protect highly sensitive and pristine subwatersheds from degradation. If development is to occur in these areas, special precautions and techniques should be used to protect the integrity of these areas. In areas with existing regional stormwater management, additional stormwater practices may not be needed, though on-site techniques such as rain gutter disconnection should be encouraged. The remaining areas can be developed within the current JCC stormwater management criteria. The watershed was divided into 64 catchments and stormwater management criteria which have been set for different types of catchments. Table 1.4 summarizes the eight top priority stormwater retrofit sites. More information on the stormwater management recommendations can be found in Section III.

Outcomes

- Special Stormwater Criteria (SSC) for stream protection and conservation areas
- 8 priority stormwater retrofits (described in Table 1.4)
- 5 locations for potential regional facilities
- Stormwater criteria specifically for the tidal mainstem of Powhatan Creek to address water quality issues
- Locations for areas where the current stormwater criteria should be used
- Locations for areas where no additional stormwater management is needed

Powhatan Creek Watershed Management Report

Table 1.4 Priority Stormwater Retrofits

Rank	Retrofit	Drainage (acres)	Total Points	Description
1	R207-4	80	49	Proposed Extended Detention (ED) pond upstream of Longhill Rd, proposed stream rehabilitation downstream
2	R202-1	250	45	Modification of outlet structure of dry pond to provide channel protection
3	R205-2	120	45	Retrofit of an existing dry pond to provide channel protection
4	R207-3	70	39	Proposed expansion of existing pond to provide ED
5	R206-3	60	37	Outlet modification to provide channel protection at the Prime Outlets dry pond, also site of potential stream rehabilitation
6	R206-4	110	35	Outlet modification, possible micropool addition to dry pond
7	R208-2	30	27	Potential modification to outlet structure of wet pond to provide channel protection
8	R210-1	6	26	Potential modification of dry pond to provide channel protection, potential for conjunction with stream rehabilitation
**Further details can be found in the <i>Powhatan Creek Stormwater Master Plan</i> (Zielinski, 2001).				

Section II: Watershed Goals

The public and other stakeholders play a vital role in the creation and implementation of a watershed management plan. It is important to involve the citizens, businesses, and other interested parties in the development of the watershed plan, since they will have to live with the decisions that are made. Stakeholders also bring to the table the issues that are important to them. Their participation gives them a stake in the outcome and helps to ensure the implementation of the plan. Two meetings were held with watershed stakeholders; the first introduced the baseline assessment and fieldwork that was performed by the Center, the second engaged participants in the process of setting goals for the subwatersheds as well as the watershed as a whole. After receiving input from residents and other watershed stakeholders on what goals were deemed important to the community at large, the following set of principles were drafted to guide recommendations of the Powhatan Creek Watershed Management Plan:

1. Prevent further degradation of water quality in Powhatan Creek and maintain the outstanding quality of tidal and nontidal mainstem wetlands. Extend RPA's to protect all perennial streams and connected wetlands.

Many stakeholders felt that the County should try to improve water quality rather than simply prevent it from getting worse. With the exception of fecal coliform and slightly elevated nutrient loading, water quality is fairly good throughout the watershed. Focusing water quality improvement efforts on reducing bacteria and nutrient loading would help reach this goal as well as keeping shellfish beds open. Currently, very little data on stormwater pollutant loads is available within the Powhatan Creek Watershed. Monitoring efforts should be expanded from baseflow studies to include the impacts on headwater streams from storm events. Greg Hancock, professor at William and Mary, and his students are currently monitoring stormflow and water quality in two headwater streams. These monitoring efforts could be expanded to include assessment of the effectiveness of the restoration and protection efforts in Powhatan Creek. The Friends of Powhatan Creek already have a good baseflow monitoring program which could benefit from increased quality control such as sending monthly samples to Virginia Institute of Marine Science (VIMS) to check the accuracy of the data they are collecting. Monitoring information is necessary to assess the overall effectiveness of the management strategies in maintaining high water quality standards in Powhatan Creek. Overall, the watershed protection strategies discussed in this report, such as reforestation and expansion of RPAs and buffers along the mainstem and tributaries, should contribute to protecting wetlands, mainstem shorelines and water quality. Additionally, adoption of better site design techniques to limit impervious cover in new developments, increased homeowner stewardship practices, and stormwater retrofits for existing development will help reduce the negative impacts of stormwater runoff.

Powhatan Creek Watershed Management Report

2. Maintain biological and habitat diversity and promote habitat connectivity by protecting wildlife and riparian corridors between watersheds, subwatersheds, and the tidal and non-tidal portions of Powhatan Creek.

As described in the Baseline Assessment and Conservation Areas reports, Powhatan Creek is one of the most outstanding natural areas in Virginia and hosts a variety of floodplain and wetland areas that are home to six RTE plant species. In addition, eagles, ospreys, waterfowl, and two heron rookeries are found within the diverse mosaic of wetlands, forests, and beaver dam complexes throughout the watershed. Watershed residents recognize the importance of protecting the habitats of these species in order to maintain viable populations. Stakeholders agree that protecting remaining large tracts of contiguous forest and riparian corridors from development and encroachment is fundamental to maintaining a healthy watershed. To accomplish this goal, the County should focus on preserving natural areas and maintaining connectivity between these areas (especially those linking Yarmouth with Powhatan). The County should continue its efforts to provide a riparian corridor along the mainstem through the RPA regulations; however, we recommend extending the RPA buffers to include all perennial streams and connected wetlands. Widening the natural buffer along the mainstem of Powhatan Creek to a minimum of 300 ft is also recommended for new development. Educational efforts and financial incentives that enhance stewardship roles of homeowners may also help in reducing buffer encroachment problems.

3. Develop an affordable and effective watershed management plan that can be implemented by James City County.

Everyone involved in the development of the watershed plan agreed that timely and effective implementation of recommended strategies is constrained by financial and political factors. By devising strategies that build upon existing regulations, programs, and policies, we can eliminate lengthy bureaucratic inertia, take advantage of established monetary resources, and better target the management budget for more expensive land acquisitions and structural stormwater practices. Examples include linking the management plan with the County's Comprehensive Plan and enhancing provisions within the Chesapeake Bay Preservation Ordinance. Utilizing existing land trusts, watershed organizations and universities to supplement land conservation, monitoring and outreach activities is another way to capitalize on existing infrastructure. Increased coordination between agencies with jurisdiction in the watershed, such as VA Department of Transportation (VDOT), City of Williamsburg, VA Department of Forestry, the Army Corp, public utilities, and the County is also integral to effective implementation of the watershed plan.

4. Establish a transparent and stream-lined permitting process, and provide cost effective and incentive-based regulations or guidelines for "green" development.

Urbanization dominates the current and future land use in many of the subwatersheds within Powhatan Creek. Recommendations for future development of residential and commercial areas focus on zoning changes and instituting flexibility in development standards which reduce impervious cover (better site design (BSD) principles). Stakeholders felt strongly that encouraging

Powhatan Creek Watershed Management Report

open space design, other techniques to reduce imperviousness, and preserving forest and buffers should not result in a complex and burdensome review and permitting process, nor should the measures be economically unsustainable. Additionally, any financial or regulatory incentives that could be provided to promote BSD, such as tax, stormwater, or density credits; or buffer averaging programs should be utilized. Innovation and creativity in creating greener development such as open space trading and increased clustering should also be encouraged.

5. Improve the existing mechanisms for completing stormwater maintenance and retrofitting, and develop a mechanism for adequate long-term funding.

While flooding remains a great concern among watershed residents, comprehensive management of stormwater practices was a high priority as well. As detailed in the Stormwater Management Plan, recommendations for retrofit opportunities, and improved maintenance of stormwater management practices are paramount to maintaining water quality in Powhatan Creek. Effectiveness of structural practices can be improved through increased inspections and maintenance enforcement. Successful retrofit project will be limited by environmental factors, monetary concerns, and public support. Strategies to help meet this goal include HOA education, and creation of a stormwater utility to fund maintenance and retrofitting projects.

6. Link the unique history and culture of Jamestown and Colonial Williamsburg with Powhatan Creek Watershed Protection.

Tourism is a significant part of the area's economy, and sustainable development of the watershed's natural resources are linked to preserving the historic character of the watershed. Powhatan Creek is where the first settlers located--an event being marked by the celebration in 2007. Many stakeholders feel that protecting the natural resources of those early settlers is as important as preserving the urban habitats of Williamsburg and Jamestown. Establishing a goal of full implementation of the watershed management plan in line with the 2007 event would provide significant public and political incentive to actively pursue management recommendations. The educational systems in place both in Williamsburg and Jamestown Settlement would also provide a unique forum for promoting watershed awareness to tourists and residents alike.

7. Promote watershed awareness and active stewardship among residents, community associations, businesses, and seasonal visitors through education programs, recreational opportunities, and participatory watershed activities.

Much of the watershed is privately owned and effective private stewardship of those watershed areas is an integral part of watershed protection. Stakeholders wanted every watershed resident to be educated on nutrient and pollution control and felt HOAs should be targeted for education on the proper techniques for home and lawn care, stormwater practice maintenance, and buffer management. The County should promote active participation in watershed activities such as monitoring, buffer planting, and policing efforts (unmaintained stormwater ponds). Passive and active recreational activities such as hiking and boating can be used to raise watershed awareness

Powhatan Creek Watershed Management Report

through trails, nature centers, fishing tournaments, and stream clean ups. Powhatan Creek already has a watershed organization—Friends of Powhatan Creek—that can distribute educational information, conduct watershed education efforts, and sponsor watershed events. A CD with powerpoint slides was created to assist with this process (Appendix B).

8. Restore the physical integrity of degraded headwater streams where possible and protect high quality streams from negative morphological impacts associated with increased urbanization.

The Stream Assessment Report provides information on the relative quality of the tributary stream network of Powhatan Creek. Some of these streams are highly impacted by development, some of which are optimal candidates for stream restoration. Stakeholders thought that restoration efforts that could effectively restore bank stability, enhance in-stream habitat, and replace stream-side vegetation should be done where possible. Greater emphasis was placed on protecting the streams currently classified as high quality from further deterioration.

Section III: Watershed Recommendations

This section presents subwatershed-based recommendations for Powhatan Creek in the context of six tools of watershed protection: land use planning, aquatic buffers, better site design, stormwater management, conservation areas, and watershed education. Each tool is introduced in detail below and is linked with overall watershed goals, James City County's current framework, and specific recommendations for Powhatan's subwatersheds.

A. Land Use Planning

Land use planning tools are needed to assist in the conservation of lands that are important to safeguarding the long-term protection of water quality, pristine streams, wildlife corridors, contiguous forest and the unique biodiversity of the Powhatan Creek watershed. The preservation of conservation areas and the mainstem corridor will allow for the protection of habitat and the movement of wildlife from Powhatan Creek to other watersheds such as Yarmouth Creek. These areas also serve as recharge sites for clean groundwater, and the buffers help to protect water quality and prevent invasive species from negatively affecting Powhatan Creek. Specific techniques which could be developed include the ability to cluster down, restrict

re-zoning in sensitive subwatersheds, and trading required open space from impacted subwatersheds to sensitive subwatersheds and the mainstem of Powhatan Creek. Land use planning tools are very cost effective. They cost virtually nothing to implement versus traditional acquisition programs which can be very expensive. Effective implementation of land use techniques requires flexibility and incentives within the zoning and development standards to motivate developers to do what is best for the watershed; so that development and safeguarding Powhatan Creek are compatible goals.

While the County has a significant framework available for utilizing land use techniques for watershed protection, we recommend some of the following strategies for enhancing land use planning as a tool. Four of these techniques are described below, and use of these techniques in specific watersheds is summarized in Table 3.1.

1. **Open Space Trading:** Open space trading would allow the reduction of the open space requirement in impacted subwatersheds (203, 204, 206, 207, and 210) in exchange for the protection of conservation areas in other subwatersheds or the mainstem buffer. When

Targeted Watershed Goals

Maintain biological and habitat diversity and promote habitat connectivity by protecting wildlife and riparian corridors between watersheds, subwatersheds, and the tidal and non-tidal portions of Powhatan Creek.

Extend RPAs to protect all perennial streams and connected wetlands

Prevent further degradation of water quality in Powhatan Creek and maintain the outstanding quality of tidal and nontidal mainstem wetlands.

Develop an "affordable and effective" watershed management plan that can be implemented by James City County.

Powhatan Creek Watershed Management Report

development is proposed in subwatersheds targeted for growth, developers would be allowed to account for some of their open space requirement by protecting or paying a fee-in-lieu to protect a designated conservation area or the mainstem buffer. This technique also is sensible economically because land values are often appreciably greater in areas zoned for higher density. Implementation of this technique may also assist in reducing the cost of preserving and protecting the 1800 acre goal from the *Conservation Area Report*.

Specific language for this type of ordinance should include:

- Reduced open space requirement down to 10-15% in targeted growth areas in exchange for the purchase of conservation areas or the payment of a fee-in-lieu to be used to purchase targeted conservation area lands. These areas could be managed by a third party such as the Williamsburg Land Trust or Virginia Outdoors.
 - Re-zoning in growth subwatersheds should maintain the higher open space requirement of the two zoning requirements and allow for open space transfer to conservation areas.
2. Cluster Down: This zoning change would allow the developer to build the same number of units provided in its current zoning, but would reduce individual lot sizes and therefore reduce the overall development footprint while increasing additional contiguous forest, conservation area or stream buffer beyond its set open space requirement (ie. 10% or 40%). This would primarily affect developable lands which are adjacent to or part of conservation areas (especially contiguous forest), and areas adjacent to the mainstem of Powhatan Creek. This technique is particularly applicable in subwatersheds 201, 202, 205, 208, 209 and along the tidal and nontidal mainstem. Incentives for developers to cluster down include reduced infrastructure costs, and potential added value to the homeowners who know that the adjacent land will be preserved.
 3. Limit Re-Zoning in Sensitive Watersheds: Changes in zoning that would increase impervious cover and allow for more intense urbanization than current zoning permits should be prohibited. The ability of the county to restrict the re-zoning of lands in sensitive subwatersheds and conservation areas is crucial to the protection of the integrity of the Powhatan Creek watershed. In contrast, granting re-zoning requests in these areas would act to increase the development value of these lands making it more difficult for land conservation programs to be successful.
 4. RPA Extensions: Extension of the Resource Protection Areas (RPAs) to include all perennial streams and connected wetlands beyond the USGS blueline designation is another recommendation for the increased protection of Powhatan Creek's resources. This recommendation is also being proposed by CBLAD in their revisions to the RPA regulations. The Center has made recommendations based on our reconnaissance during our fieldwork (See Appendix C). One stakeholder group also recommended that steep slopes be included

Powhatan Creek Watershed Management Report

within the RPA boundary, this has been instituted by several other Virginia jurisdictions and may assist in increasing the width of the mainstem buffer. In the Yarmouth Creek watershed plan, the Center will make an even more formal recommendation on the extension of RPAs beyond the blue lines based on our fieldwork.

Table 3.1 Land Use Strategies for Powhatan Creek Watershed			
Land Use Tool	Target Areas	Subwatershed	Description
Open Space Trading	Impacted subwatersheds; Targeted growth areas	203, 204, 206, 207, 210	This technique allows for the reduction of open space requirement in areas targeted for growth in exchange for increased open space protection of conservation areas or in association with the protection of mainstem buffers.
Cluster Down	Development adjacent to buffers or conservation areas	201, 202, 205, 208, 209, Tidal and non-tidal mainstem	This technique maintains overall site density, but reduces lot sizes and imperviousness and adds resulting open space to adjacent buffer or conservation area.
Restrictive Re-Zoning	Sensitive areas	201, 202, 205, 208, 209, Tidal non-tidal mainstem	This tool prohibits changes in zoning that would result in increased imperviousness.
RPA Extension	All perennial streams and connected wetlands	all subwatersheds	This would extend protective RPA boundaries to all perennial streams and connected wetlands.

B. Aquatic Buffers

Aquatic buffers are an important element in a comprehensive watershed protection strategy. While generally limited in their ability to remove pollutants in an urban setting, a well-established and unbroken buffer network provides many benefits to overall watershed health. In addition to separating development from the stream system, buffers help maintain aquatic and terrestrial transition zone habitats, provide a wildlife corridor, protect sensitive wetland and floodplain areas, and reduce the impact of invasive species. Buffers serve as a "stream right-of-way" allowing for lateral movement, protecting private property from flooding, and helping reduce watershed imperviousness. A good buffer program generally meets the following criteria:

Targeted Watershed Goals

Prevent further degradation of water quality in Powhatan Creek and maintain the outstanding quality of tidal and nontidal mainstem wetlands

Maintain biological and habitat diversity and promote habitat connectivity by protecting wildlife and riparian corridors between watersheds, subwatersheds, and the tidal and non-tidal portions of Powhatan Creek.

Restore the physical integrity of degraded headwater streams where possible and protect high quality streams from negative morphological impacts associated with increased urbanization.

- Minimum width of 100 ft (JCC meets this criteria)
- Three-zone buffer system with specific goals and restrictions for the outer, middle, and streamside zones (may be appropriate with a larger mainstem buffer)
- A vegetative target based on pre-development plant community
- Clear and measurable criteria for delineation of buffer origin and boundaries
- Limited numbers and specific criteria for stream and buffer crossing
- Carefully prescribed use of buffer for stormwater treatment practices
- Highly visible buffer demarcation before, during, and after construction
- Commitment to buffer education and enforcement

Protection and management of aquatic buffers in the Powhatan Creek Watershed relates mainly to the County's Chesapeake Bay Preservation Ordinance and silviculture practices. Under the Chesapeake Bay Preservation Ordinance, the entire watershed is a designated Chesapeake Bay Preservation Area that establishes a 100 ft Resource Protection Area (RPA) buffer adjacent to and landward of connected tidal and non-tidal wetlands, tidal shores, and tributary streams. Tributary streams are defined as any perennial stream depicted on the most recent USGS 7.5 minute quadrangle map. Under this RPA system, James City County has maintained a significant riparian corridor along mainstem Powhatan Creek. However, many perennial streams, and their connected wetlands are not protected under this ordinance and less stringent buffer requirements are allowed. Silviculture practices are exempt from the Virginia Chesapeake Bay Act, provided that operations adhere to water quality protection procedures prescribed by the VA Department of Forestry in its Best Management Practices (BMP) Handbook for Forestry Operations. No evidence of forestry BMPs were seen associated with several timber harvesting operations observed during our fieldwork.

Powhatan Creek Watershed Management Report

While James City County has an established buffer program, we have identified areas of concern that may limit the overall effectiveness of the watershed's existing buffer network. The RPA boundary does not include all hydrologic and ecologically critical headwater reaches (including perennial streams) or sensitive floodplain areas within the watershed. Demarcation of the RPA buffer areas is an important tool in ensuring on-the-ground visibility of buffers and helping to prevent encroachment by property owners unaware of the boundaries and proper management of their buffer. In Powhatan, some signage for the RPA was noted during the fieldwork in the tidal portion of Powhatan Creek, these program should be extended to the other areas within the watershed.

Recommendations for enhancing the buffer system in the Powhatan Creek watershed range from RPA and existing buffer expansion, strategic utilization of land use planning and site design techniques, clearly defining buffer management criteria, and increasing buffer awareness. We have grouped buffer improvements into the following six categories described below.

1. RPA Extensions: It is our opinion that current RPA boundaries clearly do not extend to all perennial streams within the watershed. We recommend using the layer created by the Center through our fieldwork, with perhaps further refinement during an extended dry period using county staff or William and Mary. USGS 7.5 minute quad sheets are often not a good measure of perennial streams. For example, the stream pictured on the cover (after an extended drought) is labeled as a intermittent stream on the USGS quad sheets.
2. Inclusion of intermittent streams and unconnected wetlands within a buffer system: Limiting RPA protection to connected perennial streams and wetlands does not protect sensitive intermittent headwaters and "pocket" wetlands. These areas may provide critical habitat for RTE species, contain contiguous forests, or impact the water quality of receiving streams. Current standards do not define any buffer for these areas unless they are protected by wetlands regulations. The County should consider a 100 ft buffer for significant pocket wetlands and a 50ft buffer for intermittent streams.
3. Buffer reclamation, widening, and revegetation: Identification and reclamation of encroachment areas, in addition to the restoration of native pre-development vegetation throughout the buffer complex is critical to maintaining the integrity of the watershed's buffer network. Programs and encouragement to aid buffer revegetation in areas cleared and developed prior to RPA regulations can be very beneficial. Buffer widths should be increased as necessary to include special habitats or provide additional separation between development and the waterway. The non-tidal portion and tidal mainstem Powhatan Creek, for example, should increase existing minimum buffer widths from 100 to 300 ft. to help maintain the outstanding tidal marshes, marsh transition zone, and the immediate shoreline.
4. Buffer Management Criteria: Clear vegetative targets and criteria for crossings (road, utility, and golf courses), maintenance, and enforcement should be standardized. Visible signage should be a part of the development process from pre-construction to the occupancy stages.

Powhatan Creek Watershed Management Report

5. Directing of required open space or natural areas derived from clustered development to riparian buffer areas: The county should look for opportunities to expand the buffer area in developing areas by utilizing open space and cluster design developments. In these cases, the open space areas can be directed towards and added to the existing riparian buffer area. Buffers can serve as a sink for required open space and may even provide an off-site mitigation location for diversion of open space requirements.
6. Watershed education on buffer management: Homeowners, lawn care companies, and community management entities should be educated on the benefits of a buffer network and proper vegetative management of buffer areas within their care.

While opportunities exist to enhance the buffer network in all subwatersheds, specific measures are tailored to each of the subwatersheds depending on variations in existing RPA boundaries, stream quality, levels of buffer encroachment, development history, and future land use. Specific recommendations are summarized in Table 3.2.

Table 3.2 Buffer Strategies for Powhatan Creek Subwatersheds	
Subwatershed	Comments and Recommendations
Mainstem Tidal	Several RPA buffers are not maintained in a forested condition, most of which were developed prior to the Chesapeake Bay Preservation Act Buffer education Establish program to assist landowners in creation of buffer zones Preservation of a larger natural buffer (minimum 300 ft) on new development to protect marsh transition zone Cluster development to protect marsh buffers
Mainstem Non-Tidal	High quality stream habitat Contains a priority Stream Protection Area Increase width of mainstem buffer to 300ft to preserve contiguous forest and limit invasive species
201	Open space clustering of low density residential on east side of Paleochannel to preserve buffer Increase forested buffer on Paleochannel wetlands Expand RPA to include Paleochannel
202	Good stream quality Concentrate required open space along streams and wetlands
203	Golf courses and backyards -- Look for opportunities to increase buffer widths and reduce number of crossings
204	Possible RPA extension Homeowner education on buffer management
205	Best stream habitat in watershed Cluster or open space design to protect stream valleys
206	Reforestation/vegetation of buffers during stream restoration

Table 3.2 Buffer Strategies for Powhatan Creek Subwatersheds	
207	Use open space requirements to increase buffers on 1st order and intermittent streams Allow for off-site open space transfer to protect buffer areas
208	Excellent stream habitat scores RPA extensions Concentrate required open space along streams, wetlands, and conservation areas
209	Excellent stream condition RPA extensions Concentrate required open space along streams, wetlands, and conservation areas
210	RPA extensions Concentrate open space along streams and wetlands or in the mainstem corridor Homeowner education on buffer management

C. Better Site Design

Better site design (BSD) is a critical tool for watershed protection and could be more effectively implemented in the Powhatan Creek watershed. BSD techniques incorporate a combination of 22 model development principles designed to reduce impervious cover, minimize clearing and grading during construction, and maintain native vegetation on-site. BSD is a tool for allowing flexibility and creativity in designing residential and commercial areas

scheduled to be developed; therefore, better site design is not an issue of zoning or future land use, rather it is a means of producing the most environmentally sensitive development possible. One of the primary benefits of BSD, the reduction in impervious cover, is particularly relevant to this watershed because it equates to less stormwater impact on the water quality of Powhatan Creek. The 22 model development principles, are organized into three groups, as listed below; residential streets and parking lots, lot development, and conservation of natural areas.

Targeted Watershed Goals

Establish a transparent and stream-lined permitting process, and provide cost effective and incentive based regulations for “green” development.

Develop an affordable and effective watershed management plan that can be implemented by James City County.

1. Residential Streets and Parking Lots: Ten techniques for reducing car habitat in new developments by reducing residential street widths and lengths, Right of Way (ROW) widths, and the quantity and size of cul-de-sacs; promoting alternative turnarounds, vegetated open channels, and porous paving; assessing parking ratios and requirements; and by providing

Powhatan Creek Watershed Management Report

compact stall dimensions, incentives for structured parking, and integrated stormwater treatment with parking lot landscaping.

2. Lot Development: Six techniques for reducing imperviousness by modifying the shape, size, and layout of residential lots. This includes advocating open space design subdivisions that incorporate smaller lot sizes, reduce construction costs, conserve natural areas, and promote watershed protection. Relaxing yard setbacks and frontages, promoting flexible sidewalk and driveway standards, disconnecting rooftop runoff, and specifying open space management are principles for better lot design.
3. Conservation of Natural Areas: Six techniques for conserving and managing the natural areas at the development site include creation of a variable width, naturally vegetated, well-marked buffer; limited clearing and grading of forests and natural vegetation on site; conservation and incorporation of on site vegetation; restriction of stormwater outfalls; and provision of incentives to encourage conservation.

In reviewing its development codes and standards, the JCC received a relatively high score on the codes and ordinance worksheet (COW) assessment (Appendix D). The COW assesses the extent to which local codes and ordinances allow or prevent the model development principles from being implemented by developers. James City County development standards appear to allow usage of many of these principles such as open space requirements, cluster development, and buffer requirements. The County scored 75 out of 100 points—indicating that opportunities exist to improve the county's development codes. In the self assessment, JCC identified three major areas in its codes that may limit environmentally-friendly development. These included: parking requirements, setbacks and frontages, and street standards. Scoring was as follows:

COW Points				
Principle	Category	JCC	Maximum	Percent
Principles 1-10	Residential Streets and Parking Lots	27	40	67.5 %
Principles 11-16	Lot Development	26	36	72.2 %
Principles 17-22	Conservation of Natural Areas	22	24	91.7 %
		75	100	75.0%

Although most of the better site design tools are available to developers, in the field, it appeared that in much of the new development, BSD aspects were not being utilized. Regulatory, economic, and educational barriers to BSD usage must be identified and addressed if the Powhatan Creek watershed is to benefit from this protection tool. Recommendations for improving the County's ability to utilize better site design techniques include code revision in some of the areas identified previously, increased education of developers and planning staff, the provision of incentives for developers to